

BILLINGS (J. S.)

HYGIENE IN UNIVERSITY EDUCATION.

BY

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THE division and specialization of labor, which are characteristic of modern civilization, are applied in educational affairs, as well as in the supply of clothing, food and habitations for the people. Your beds and houses, bread and shoes, are such as they are, and not such as men had when the first students gathered at Oxford — and it is within your power to obtain, as necessities of your daily life, conditions which the Tudor kings could not command as luxuries — because a few men have discovered methods of controlling and using the forces of wind, heat, gravitation and electricity ; because a larger number of men have applied their capital and brains to bringing these methods into use in collecting material, and in manufacturing and distributing the products ; and because a multitude of other men have given bodily labor, for daily wages, to carry out the plans of their employers, each laborer doing but a very limited kind of work. In like manner the fact that you are about to receive practical, useful information as to the laws of life and death, the causes of certain unnecessary disease and suffering, and the means whereby these may be averted or prevented, depends on the fact that about half-a-dozen men have spent years in making observations and experiments, and in devising methods for the determination of the nature of these causes, that a hundred other men have made it their life work to apply these methods of investigation to the details of particular

¹ Address given to the University Extension Classes, Oxford, England, August 7, 1894.



diseases, and that a much larger number of men have studied the results thus obtained and are engaged in their practical application and in teaching others how to use them. All of these agencies are necessary to obtain the end desired, but they are not all equally important, because some of them are more easily obtained than others, yet we need them all. We must have means to provide for increase of knowledge in hygiene, as well as to provide for the diffusion of such knowledge by means of university extension lectures and other agencies, because, as I shall try to show you, there are many things of great importance in practical hygiene which are as yet unknown.

When I had accepted the honor conferred upon me by the request to give this lecture, it became a serious question as to what I should talk about. I could only guess at the character and needs of an audience of university extension students, and as to what your lecturer on hygiene would include in his course; but on thinking over the matter, it occurred to me that some of the relations of hygiene to university education might serve as a nominal thread upon which to string a few suggestions which may be of interest to you just at the present time. University education in hygiene is another matter, including but a part of the field covered by my broader title, and if we were to limit it to the present condition of things — that is, to answering the question, "What does a university education in hygiene include?" — the answer would be a brief one. The older universities are conservative institutions, slow to change the scope and character of their work; and it is desirable that it should be so, for upon this depends a considerable part of the influence which they exercise. Scientific hygiene is a comparatively new branch of study, which, thus far, has been chiefly taken up as a part of the course in medical and technolo-

logical schools; but there are now several universities which have professors and laboratories of hygiene, whose work is not confined to the pupils in their medical departments only, and it is safe to predict that this plan will soon be adopted by all the real universities.

What should a university education in hygiene include? Wherein should it differ from the course in hygiene in a technological or medical school intended to train sanitary engineers or medical officers of health? What should be its special objects? I will not try to formulate what I suppose your answers to these questions would be now, nor yet what the answers should be if you found the questions on an examination paper, but will try to suggest one or two points which, perhaps, may not have occurred to you.

The phrase "university education" implies breadth as well as depth of culture; and a man who has received such an education in any field of science should have some definite ideas as to what questions are still *sub judice* in that field — as to what additional data are still wanted, as to what original investigators and observers are working at; in short, he should know the boundaries of our present scientific knowledge on that subject, as well as the part which has been thoroughly explored.

He cannot get this information from manuals or handbooks, nor can a short course of lectures include much of it; it is to be obtained for the most part only by actual work in investigating, which is the best of all methods to demonstrate to a man what and how much there is that he does not know. A university education in hygiene should not only include information as to the nature and relative importance of the principal known causes of disease and death, immediate and remote, but also as to the cost of the means of partially

or entirely doing away with these causes, as compared with the value of the results which may be thus obtained. It is not always worth while to be careful to avoid a danger; one may pay too much for a life insurance; there are times when one should go to battle, or meet a pestilence, or live in an unhealthy locality, when it is merely one's own life that is at stake; and there are also occasions when one should take the responsibility of leaving, or putting, in danger the lives of a few to preserve the welfare of the many. The importance and value of long life is always taken for granted in discourses upon hygiene; but if it were in your power to prolong the life of every one in England to one hundred years, would you do it? If you were offered as a gift that you should not die until you were a hundred years old, would you accept it without conditions? Why do we expend time and money to secure at public expense the preservation of the health and prolongation of the lives of congenital idiots, of the hopelessly insane, of hereditary and confirmed criminals?

If there is truth in the doctrine of the survival of the fittest, why do we interfere in the struggle for existence, and try to shift the inevitable penalties for the violation of Nature's laws upon those who have not violated them? Was Carlyle right when he said, "Let wastefulness, idleness and improvidence take the fate which God has appointed them, that their opposites may have a chance for *their* fate. He that will not work according to his faculty, let him perish according to his necessity?" When you come to consider these and similar questions, you will see that the problems of hygiene are not merely mechanical, chemical, bacteriological, and medical; they embrace, also, sociological, political, and ethical considerations, and the world needs some "all-round men" to study them. Such

men the great universities should endeavor to equip for this work.

The part which epidemic diseases have played in shaping the destinies of cities and of nations has rarely been investigated by historians. Even the two greatest epidemics of which we have any record, the Justinian plague and the Black Death, have received little more than a brief mention in the leading English histories; and yet each of these not only changed the map of Europe, but also exercised a profound influence upon the social customs and the religion of the people, an influence which has affected the new world as well as the old. In this connection some interesting data are given in a recent work, "The Great Pestilence (A. D. 1348-9)," by Francis Aiden Gasquet, 8vo, London, 1893, wherein the effects of the Black Death upon the Church in England are specially dwelt upon, and its results in the formation of trade guilds are briefly indicated.

The influence of epidemics on the progress of nations and communities is by no means merely a matter of ancient history.

Yellow fever has, to a considerable extent, shaped the present commercial, social, and political condition of the West Indies and Central America, of New Orleans and Rio de Janeiro. Cholera was the immediate cause of modern hygiene: its ravages have been closely connected with certain religious observances, and its prevention is still a problem which must be solved by British statesmen; while the future of the continent of Africa depends quite as much upon progress in hygiene as upon political considerations. The International Conference at Paris, only four months ago, shows that questions of hygiene play an important part in matters of international comity, and the International Congress of Hygiene and Demography which

last met in London, and is to meet again next September in Buda-Pesth, is exercising an increasing influence upon public health legislation in all countries, an influence none the less powerful because it is persuasive and not compulsory.

Your teachers in hygiene can tell you what is known with regard to the causes of disease and methods of prevention, and that is much ; for if we could induce every one to act in accordance with the teachings of the hygiene of to-day, there would be a great diminution of disease and a lengthening of life among men. But I am more concerned in this lecture to call your attention to the many things that are yet unknown, and yet which probably might be known with a little work, in matters affecting practical hygiene.

Let us take a few concrete examples. What is the cause of measles ? How is it communicated ? What is the probability that the disease can be communicated by a person after the eruption has fully developed and the diagnosis is certain ? We do not know. We know that the disease is most contagious during the three or four days preceding, and during the first day of the eruption, and that attempts to prevent the spread of the disease in a family by isolating the patient as soon as the eruption appears, rarely succeed, while the contrary is the case in scarlet fever and in small-pox. We suppose that the medium of contagion is the secretion from the upper air-passages, which is scattered in spray by the coughing and sneezing of the patient.

Does the susceptibility to measles diminish with advancing years, as does that of scarlet fever ? We do not know ; but the experience of the Faroe Islanders, and of the American recruits brought together at the beginning of our last war, indicates that while it is most fatal in children under five years of age, it may

be quite as contagious and nearly as fatal among adults as among children. Now all these are questions to be considered in deciding as to whether notification and isolation of cases of measles are to be enforced in any particular locality. We have fairly good statistical evidence that the evil effects of scarlet fever, diphtheria and small-pox have been diminished by compulsory notification and isolation ; but I know of no such evidence with regard to measles.

Measles appears to have caused at least twice as great a mortality in the large cities of England and Continental Europe during the last five years as it has in the United States ; but why this is so I cannot tell. The death-rate from measles is small as compared with that from accidents, or from many other forms of disease ; but its evil effects are not to be measured by its death-rate alone.

Dr. Hugh R. Jones,² in an interesting paper on the perils of infant life, presented to the Royal Statistical Society in December last, says : "The danger of measles has been very greatly underrated. There is no doubt but that the tuberculous diseases of childhood, whether local, as lupus and enlarged glands, or whether general and fatal, as pulmonary phthisis, are often rightly traced and attributed to an attack of measles." There is no definite evidence upon this point, which is an important one. In the United States a considerable proportion of cases of feeble-mindedness, deaf-mutism, and blindness, are attributed to measles, sometimes erroneously no doubt ; but we must certainly consider this disease as of sufficient importance to warrant special precautions to prevent its evil consequences. I doubt, however, whether it is worth while to expend much public money, or to interfere with home life, in order to prevent it among chil-

² Journal of the Royal Statistical Society, lvii, 1894, p. 15.

dren over five years of age; and the true solution of the problem will probably be the production of a mild form of the disease in children, and thus making them immune for the rest of their lives. This is practically what has been done for centuries in China with regard to this disease; and, when I was a boy, I have known people to deliberately expose their children to the infection of a mild case of measles in warm weather, in order "to get the disease through the family without risk," as they said.

Something of the same sort used to be done by northern men settling in New Orleans, in purposely exposing themselves to yellow fever when it existed in a mild type, in order that they might become "acclimated," as the phrase went.

Let us next take typhoid fever. Typical cases of this disease are caused by a specific bacillus which gains entrance to the body through food or drink contaminated with the excreta of persons affected with the disease. Epidemics are due to contaminated water or milk. The stools of a typhoid case can be cheaply and easily disinfected so as to destroy the specific bacillus, and I presume that many persons think that we know all that need be known to stamp out typhoid fever or, as the English registrars call it, enteric fever. In the United States, however, we have many cases of mild continued fever, lasting from twenty to thirty days, which we presume to be typhoid fever, but which are certainly not typical, and which shade into continued malarial forms of fever in a very puzzling way. There are also several known varieties of the typhoid bacillus; and it is not quite certain that one or more of these varieties do not exist at times in the intestinal tract without producing a specific fever in the person bearing them.

Can the specific, active typhoid bacillus be devel-

oped from some of these, under certain circumstances, in privy vaults, cesspools, or sewage? Is the typhoid bacillus carried in currents of sewer air? Are not all the cases in which it has been supposed to have been thus carried to infect men, more easily explained in other ways, as, for example, by the supposition that it has been conveyed to articles of food or drink through the agency of flies and other insects? What degree and duration of immunity from subsequent attacks does an attack of typhoid fever confer on a man? Is there any difference between the immunity conferred by a mild, and that conferred by a severe, attack? Are there attenuated varieties of the typhoid organism? Can these be developed into more dangerous forms under certain conditions? Can they be used to produce immunity?

All of these are as yet unsolved, yet probably solvable problems: and there are similar ones connected with each of the known and unknown pathogenic micro-organisms upon which bacteriologists in various parts of the world are working. Tuberculosis causes, in England and the United States, much more suffering and loss of life than any other single form of disease; more than cholera, yellow fever, small-pox, scarlet fever, typhoid fever, measles and diphtheria put together. Its immediate or efficient cause, the bacillus, has been carefully studied; and some of the modes of its transmission, through dried sputa, milk, etc., are fairly understood. To what extent heredity is a factor in its transmission, we do not know. Quite recently, in many places in the United States, it has been proposed to limit its ravages by means of compulsory notification, isolation of the sick, disinfection of their surroundings, and official supervision of milk and meat supplies; and, in a few places, some of these methods are being tried. The results of these experi-

ments will be watched with great interest ; they are good examples of the steadily increasing tendency to interfere with the liberty of the individual for the supposed benefit of the community.

The death-rate from consumption has been diminishing for the last twenty years in the eastern portion of the United States, and in most countries from which we have reliable statistics. Part of this decrease in the death-rate is probably due to improvements in food supply and in general sanitation, involving greater cleanliness and more exposure to sunlight, which last is one of the most powerful agencies in destroying the infection of tuberculous sputa scattered in the streets ; a part of it, during the last ten years, is due to the education of the people as to the necessity of promptly disinfecting the sputa of tuberculous patients ; and a part is probably due to a gradual increase in the proportion of persons who are immune against small doses of the tubercle bacillus, which increase is brought about by the law of natural selection. I shall refer presently to this immunity as connected with race, in relation to consumption, and also to pneumonia, another very fatal disease due to micro-organisms.

Now let us take an entirely different field of hygiene, namely, the effects produced on the health and life of men by inhaling air which has recently been expired by themselves or other men, and which also contains the exhalations from their skins.

It is generally accepted as a truism that air thus vitiated is dangerous to health, and that ventilation of living-rooms, bedrooms, barracks, school-rooms, etc., is an important sanitary measure. Forty or fifty years ago the danger was supposed to be due to carbonic acid, and the popular ideas on the subject are contained in the school-boy's composition on "Breath." He said :

"Breath is made of air. We breathe always with our lungs, and sometimes with our livers, except at night, when our breath keeps life going through our noses while we are asleep.

"If it wasn't for our breath, we should die whenever we slept. Boys that stay in a room all day should not breathe; they should wait till they get out-doors. For a lot of boys staying in a room make carbonic acid; and carbonic acid is more poisonous than mad dogs, though not just the same way."

For the last thirty years the danger has generally been attributed to exhaled organic matter of unknown composition, but with poisonous properties, while within the last two years several experimenters have announced that the organic matter is not dangerous, and several researches are now going on to settle this important question.

Now, what are the effects upon men of exposing them for eight or ten hours a day to air rendered impure by their own exhalations, and to what particular change in the air are these effects due?

From the days of the English Barrack Commission down to about ten years ago the answer was, that such air produced consumption and other pulmonary diseases. Now that we know that consumption and croupous pneumonia are produced by specific bacteria, the question is whether, if these bacteria are destroyed and kept out of inhabited rooms, which can be done to a very great extent, the foul air of an ordinary room will produce disease, and if so, what sort of disease. We do not know — and, therefore, we cannot produce scientific demonstrative evidence to convince architects and engineers that each man ought to have a certain stated supply of fresh air per minute or per hour, and that it is worth the cost of special apparatus to ensure this. Much the same may be said about the

supposed injurious effects of sewer air, since we have no accurate knowledge or satisfactory evidence with regard to these effects.

There are two or three times as much sickness, and two or three times as many deaths, in crowded tenement-houses as in single dwellings of the better class, and these tenement-houses are unventilated or badly ventilated; but how much has the bad ventilation, and how much the general want of cleanliness, insufficient and improper food, alcoholism, and vice of various kinds found among the tenement-house population, to do with this matter? And what are we to say about the low death-rate in tenement-houses occupied by Jews, except that race seems to exercise a powerful influence in producing this result?

In the course of lectures on hygiene which you are to have, you will no doubt hear much about the pathogenic bacteria, as causes of tuberculosis, typhoid fever, diphtheria, pneumonia, wound infections, cholera, etc., since an understanding of their nature, habits, and modes and conditions of growth is essential to the proper dealing with contagious and infectious diseases of all kinds, even those for which no specific micro-organisms have yet been discovered. But there are other things besides micro-organisms to be considered in matters of personal, national, or international health, because even for those diseases of which they are the immediate cause, there are remote causes of great importance, such as heredity, poverty, ignorance, climatic conditions, overcrowding, alcoholism, occupation, and other things which destroy many without the aid of specific bacteria, and do much to make possible the destructive work of such organisms.

My friend, Sir Henry Acland, suggested to me that I should take "Comparative National Health" as the subject for this lecture, and any suggestion from

him is to me almost equivalent to a command ; but it is beyond my power to indicate even the boundaries of so broad a field as this within the limits of a single lecture, and I can, therefore, only touch upon one point connected with it, namely, the relation of race to health.

During the twenty years ending in 1890, the annual death-rate in Austria was 30.6 ; in Italy 28.6 ; in Prussia 25.6 ; in France 22.8 ; in Belgium 21.4 ; in England and Wales 20.3 ; in Ireland 18 ; in the United States 18 ; and in Sweden 17.6, per 1,000 of living population.

Such figures, however, prove very little, for in comparing the vital statistics of different countries and nations, either as to general death-rates or death-rates due to particular diseases, it is impossible to say what proportion of the difference observed is due to differences in climate and food, and what to race peculiarities. This difficulty can be in part avoided by examining the vital statistics of different races living under the same conditions as to climate, etc. ; and the data coming from certain portions of the United States, which is now the great mixing-ground of races, are especially valuable in this respect.

In 1890 the city of New York contained about 335,000 white persons whose mothers were born in America, and 25,000 colored ; 400,000 whose mothers were born in Germany ; 400,000 whose mothers were born in Ireland ; 120,000 Russian and Polish Jews ; 55,000 Englishmen ; and 54,000 Italians. You will see that it had a larger Irish population than any city in Ireland, and that but three cities in Germany exceed it in the number of German population.

Taking the deaths among persons fifteen years old and upwards for the six years ending May 31, 1890, we find that the annual death-rates per 1,000 of popu-

lation in these different races are as follows : Irish, 28 ; colored, 23.6 : English, 20.8 ; Germans, 17.0 ; Americans 16.0 ; Italians, 12.3 : Russian and Polish Jews, 6.2.

The low death-rate of the Jews has been noted in Germany and France also. In New York City they occupy some of the most crowded tenement-house districts. A considerable number of those reported as Germans were Jews with a low death-rate ; and if these could be separated, the death-rate of the Germans would probably be over 19 per 1,000.

These are general death-rates only. Let us see what the figures are for certain causes of death. The annual death-rates for consumption were, for each 100,000 persons : colored, 774 ; Irish, 646 ; Germans, 329 ; Americans, 205 ; Russian and Polish Jews, 98. For pneumonia, the death-rates per 100,000 persons of all ages were : Italians, 456 ; colored, 390 ; Irish, 344 ; American whites, 273 ; English, 269 ; Germans, 214 ; Russian and Polish Jews, 170.

I will not weary you with further details of figures, which those of you who are specially interested in the subject will find in the Reports of the Vital Statistics of the Eleventh United States Census, but will merely say that the corresponding data from Boston, Philadelphia, Baltimore, Washington, and from the New England States as a whole, taken with those from New York State and New York City, and with those derived from a special investigation of over 10,000 Jewish families, including over 50,000 persons, lead to the following conclusions as being probable for the United States :

(1) The colored race is shorter-lived than the white ; and has a very high infantile death-rate : it is specially liable to tuberculosis and pneumonia, but is less liable than the white race to malaria, yellow fever and cancer. (2) The Irish race has a rather low death-

rate among its young children, but a very high one among adults, due to a considerable extent to the effects of tuberculosis, pneumonia and alcoholism. (3) The Germans appear to be particularly liable to disorders of the digestive organs and to cancer. (4) The Jews have a low death-rate and a more than average longevity; they are less affected than other races by consumption, pneumonia and alcoholism, but are especially liable to diabetes, locomotor ataxia and certain other diseases of the nervous system.

The effects of heredity upon liability to diseases and death appear to be due in part to difference in structure and composition of the tissues and fluids of the body, but to a much greater extent to differences in place and mode of life connected with relative poverty and ignorance.

The bacillus of tubercle and the micrococcus of pneumonia are affected as to their growth and development by hereditary peculiarities of structure of men; in other words, just as many individuals are more or less immune against these organisms under ordinary circumstances, so, also, are certain families and races; and the same is true as regards a large number of the contagious diseases, as well as some which are not contagious so far as we now know, such as cancer, diabetes, hystero-epilepsy, and scleroses of the brain and spinal cord.

Can this relative immunity be developed or increased in an individual or a family by artificial means, or by regulations of the habits and modes of life? And, if this can be done, what effect will the production of immunity against one micro-organism or disease have upon the effects of another micro-organism or cause of disease?

If we can produce a branch of the Irish race which will be as immune against the bacillus of tuberculosis

as are the Jews, will that race be specially liable to diabetes or cancer?

As all men must die, the effect of stamping out one particular form of disease must be to increase the number of deaths from other causes, and in this sense it is true that vaccination has increased the number of deaths from accidents, from suicide and from consumption, because it has preserved children from small-pox to die at a later period from these other causes; but we have not a particle of evidence that the immunity against small-pox produced by vaccination is the cause of, or is accompanied by, a less immunity against some other disease.

It should be remembered that for all diseases of which one attack produces immunity, the tendency is, in the course of many generations, to make the whole population subjected to such an influence immune.

Perhaps some of you may think that such questions as I have suggested are purely theoretical, unanswerable, and, therefore, of no practical interest; but it is not so. Some of them, if not all, can be answered, and they ought to be answered. To do this, new lines of investigation must be opened — partly experimental, in well-appointed laboratories; partly by collective investigations by medical men and in hospitals; partly by new methods of statistical research based on disease, as well as on death-registration and the census.

And the universities should train some men to understand the importance of this work — the men who are to become legislators and heads of departments, and some other men who can do the work if means and opportunities are afforded them.

Observe that I say "should train some men," not "should train all their students." Of every hundred students at a university, not more than half-a-dozen can be developed into original investigators and think-

ers, and probably not more than one in a thousand can ever be induced to devote himself seriously to such problems as I have indicated, because, as a rule, the only reward that can be expected is the satisfaction derived from the work itself. Such work requires much time, great skill and patience, and the opportunities which only a well-equipped laboratory or an official position can furnish.

The universities cannot produce the men qualified to do such work—"God alone can make an artist or a man of science"; but they can take care of such men when they appear, and can give them opportunity and encouragement.

If we accept the ordinary definition of hygiene as being the art of preserving and improving health, it is not so much this technological matter that a university education should include as the scientific foundations upon which the art rests. It does not appear desirable that every university man should know the proper gradient of a sewer, the best form of traps and house-drainage fixtures, the peculiarities of patent ventilators, or the proper construction of a hospital for contagious diseases, any more than he should know how to treat a case of pneumonia, or how to draw up a conveyance of a piece of real estate; but he should know where to go for accurate and reliable information and advice on these subjects.

It is now generally admitted that biology is a branch of science for which universities should provide the means of increase and of diffusion of knowledge; but it has not yet been generally understood that morphology and physiology, as ordinarily provided for in university work, do not cover the most important part of biology, that part to which they are merely necessary preliminaries, that part which is the main reason for their existence, and without which they rest on

narrow scientific foundations, namely, pathology. We cannot be said to understand the structure and functions of an organ until we know what these are in its abnormal as well as in its normal condition. It is to experimental pathology in its broadest sense, including not only the study of lesions specially produced for the purpose, but also the study of the lesions produced in man and animals by disease, each case being one of nature's experiments, that we must look for the most valuable explanations of peculiarities of structure and function, for explanations of the mode of action of physical, chemical and vital agencies in the production of disease, for means to counteract the abnormal conditions and actions of organs and tissues; in short, for the scientific foundations of hygiene.

It appears to me that at the present time the majority of the English and American universities are in urgent need of a department of pathology properly equipped for original research and for teaching, not as a mere technological matter, or as merely a branch of the medical department, but as a department of general biology; and the organization of such a department should precede or accompany the organization of a department for the promotion of scientific hygiene.

A paper on "Hygiene in University Education" should certainly include something about the preservation of the health of teachers and pupils, the means by which they are to be kept most fit for their work, with due consideration of the influence of athletics, of cramming (whether mental or physical), of competition under pressure of examinations, etc., upon the complicated and curious mechanism of the human body; but I must leave this to others, and I do so with the less reluctance because I think that advice on these points is of little use in comparison with personal experience.

While I lay stress on the promotion of original research in problems of hygiene as one of the most important functions of a great university of the present day, it is by no means its only one. It is also to train teachers, men who can explain to others what is really known on these subjects, and the consequences thereof, in a fashion which will command attention, interest, and belief. It is knowledge of the truth about these things which frees a man from much unnecessary pain, causeless fears, and useless labor, and from being swindled in a thousand ways; and I presume that this university extension course in hygiene is intended to furnish knowledge, and also to create a thirst for more.

To one who has had little practical experience in sanitary matters, the importance of educating the people on this subject is not sufficiently apparent, although he may admit it as a matter of theory. He is too apt to suppose that the people at large can be made healthy by regulations enforced by officials employed for the purpose. He wants laws to suppress tuberculosis, puerperal fever, cerebro-spinal meningitis, etc., by means of enforced notification, isolation and disinfection. He would have a certain hourly supply of fresh air furnished by law to every sleeping-room; would compel every one to take a bath every day, or at least once a week; would have all food officially inspected, and prohibit the use of alcoholic drinks and tobacco to men under fifty years of age; would not allow the sale of corsets, or of shoes which do not conform to the natural shape of the foot; would regulate the hours of study and of exercise for school-children, and have inspectors examine their toys and picture-books for dangerous colors; in short, it is difficult to foretell what he would not do by legal process, if he could, to prevent what he thinks is injurious to life and health,

and as a general rule he will find plenty of people who will passively assent to such propositions.

Perhaps, on the same ground, may be advocated the refusal of permission to marry unless both parties to the contract have been approved by skilled inspectors, or the official assignment of persons to particular occupations best suited to their health. It is possible that (by these and other regulations which will no doubt occur to you) a healthy community might be produced in time, provided that great care was taken to prevent any one from getting away.

And no doubt the civilized part of the world is at present tending to increasing interference with the liberty of the individual for the real or supposed benefit of the community; but attempts to hasten this progress in advance of the education of the community, or without due consideration of the manifold social, commercial and professional, as well as the sanitary, interests involved are not likely to produce good results; on the contrary, it is probable that their remote effects may be the injury of the very cause which their enthusiastic advocates are trying to promote. You cannot legislate a new layer of cortical gray matter into, or a cirrhosed liver out of, a man.

It has been said that the car of progress has square wheels; at all events, it bumps horribly sometimes, and the results of going too fast may be very unpleasant, even if they are necessary.]

Thirty years ago Dr. Parkes remarked that "in the scheme of Providence it may not be meant that men shall be healthy," and asked whether the belief that in the future there may be an art of hygiene which will keep the body, mind and soul in perfect order is merely "one of those dreams which breathe a blind hope into us, a hope born of our longings and destined to die of our experience."

“ After all the stormy changes, shall we find a
changeless May ?

All diseases quenched by Science ; no man
halt, or deaf, or blind ;

Stronger ever born of weaker ; lustier body ;
larger mind ? ”

The scientific foundations of practical hygiene have been immensely broadened and strengthened within these thirty years ; and within the same period, in most civilized countries, the death-rates have been lowered, the average duration of life increased, and life, while yet it endures, has been freed from some of its pains and terrors. But the community of perfectly healthy men and women does not yet exist, nor is it possible that such a community, if found, could continue to exist indefinitely if the present rate of increase of population of the earth shall continue.

Sewage is inseparable from humanity ; and each one of us carries about within himself millions of bacteria, which usually help him to digest his food, but which at times wander into his tissues and produce mixed infections which tax the utmost skill of the physician and surgeon to treat.

In studying medical and vital statistics to determine the influence of sanitary work in obtaining purer water-supplies, better drainage, greater isolation and restriction of contagious diseases, etc., we are “ somewhat in the position of a man on the deck of a large Atlantic steamer out of sight of land, and gazing on the troubled ocean. He sees many waves, large and small, apparently moving in very different directions ; and it is not until he has by careful examination and repeated comparison learned to distinguish the ripples due to the wind now blowing, the larger cross-seas resulting from forces which were acting a few hours before, and the long, rolling swells which indicate to some extent the direction and force of the tempest of yesterday,

that he can begin to understand the roll of the ship on which he stands: while to appreciate the force and direction of the great current which is sweeping with it all the troubled water and the ship itself, requires skilled observation with special instruments, and the use of charts which embody the experience of hundreds of voyages. So, also, in viewing the records of human life, disease and death, the variations which are at first most perceptible are often those which are most superficial, and which give little or no indication of the magnitude and direction of the movement of the great masses beneath.”³

During recent years the birth-rate has been diminishing in proportion to population in most civilized countries, as will be seen by the following table.

BIRTH-RATES PER 1,000 POPULATION.

Country.	1880.	1890.
United States	36.0	30.7
England and Wales	34.2	30.2
Scotland	33.6	30.3
Ireland	24.7	22.3
France	24.5	21.8
Belgium	31.1	28.7
German Empire	37.6	35.7
Austria	38.0	36.7
Switzerland	29.6	26.6
Denmark	31.8	30.6
Norway	30.7	30.0
Netherlands	35.5	32.9

This diminution of the birth-rate began in most countries in 1876, and is a matter of considerable importance in the sanitary as well as in the sociological problems of the future, for it must be given due consideration in making plans for regulating by law the health, the labor, and the lives of men.

³ Cartwright Lectures on Medical and Vital Statistics, New York, 1889.

What are the relations between diminishing death-rates, diminishing birth-rates, and diminishing marriage-rates? How much of the lowering of the death-rate in recent years is due to public sanitation? how much to improvements in medicine and surgery? how much to increasing immunity of the great mass of the people to certain forms of disease? how much to better and cheaper food-supplies? Is it more probable that twenty years hence the death-rates will be lower, or that they will be higher than they now are?

It seems to me that a great university which is worthy of its name should provide for the training and equipment of a few men to consider these and similar questions, and for the training of many men who are to be the future legislators for, and advisers of, the people, in such fashion that they can appreciate, and make practical applications of, the conclusions to which the special students shall arrive.

Just at present the practical problems of public hygiene relate mainly to masses of men, to cities, bound together by the iron lines of the railway and the telegraph; but as the coal supply diminishes, the cities will begin to diminish also, unless our engineers will give us some new means of storing the forces of the sun's rays, of the winds, or of the tides, and when that happens, sanitary questions will become of the first importance for all countries. "As of the leaves on a thick tree, some fall and some grow; so is the generation of flesh and blood, one cometh to an end and another is born."

Whatever happens, we must all continue to live in the shadow of the hawk's wing, as our forefathers have done, since each has but a certain span of life, which he cannot lengthen, although he may easily shorten it. He can, however, learn not to be afraid of this shadow — learn to look up and not down,

to look out and not in ; and one of the best means of doing this is to devote time and thought and labor to the helping of others to help themselves, which is the essence of public hygiene, as it is of true charity and of all real human progress.

This is a part of that wisdom of which we are all seekers, and of which such knowledge as can be gained in university halls is but a means and not an end,— that wisdom which, speaking through the poet, has said :

“ I wear no garment, drop no shade
 Before the eyes that all things see ;
 My worshippers, howe'er arrayed,
 Come in their nakedness to me.
 The forms of life like gilded towers
 May soar, in air and sunshine drest,
 The home of Passions and of Powers,
 Yet mine the crypts whereon they rest.

“ Embracing all, sustaining all,
 Consoling with unuttered lore,
 Who finds me in my voiceless hall
 Shall need the oracle no more.
 I am the knowledge that ensures
 Peace, after thought's bewildering range,
 I am the patience that endures ;
 I am the truth that cannot change.”